Massing, Ottar
A determination of generalizations basic to the mathematics curricula of the Intermediate and Senior High Schools of Canada.

University of Alberta

Faculty of Education

The undersigned hereby certify that they have read, and recommended to the Committee on Graduate Studies for acceptance, a thesis, A DETERMINATION OF GENERALIZATIONS BASIC TO THE MATHEMATICS CURRICULA OF THE INTERMEDIATE AND SENIOR HIGH SCHOOLS OF CANADA, submitted by Ottar Massing, B.Ed., in partial fulfilment of the requirements for the degree of Master of Education.

THE UNIVERSITY OF ALBERTA

A DETERMINATION OF GENERALIZATIONS BASIC TO THE MATHEMATICS CURRICULA OF THE INTERMEDIATE AND SENIOR HIGH SCHOOLS OF CANADA.

PART 4: GENERALIZATIONS OF GRADE X.

A DISSERTATION SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION.

FACULTY OF EDUCATION

OTTAR MASSING

WETASKIWIN, ALBERTA.

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INTRODUCTION

This analysis is part of a plan to compile the generalizations, information and language content of the Mathematics Courses of the Intermediate and High School grades of the various provinces of Canada. Such a compilation will when completed present to educators and students a complete summary of the material taught in the above grades. As this is the second investigation in the series to be completed the same method of organization and arrangement has been followed as was used by Mr. Gordon C. French in his study of the Grade IX course in 1944.

The following points regarding the organization and arrangement of the material in these pages will need to be understood by the reader.

1. The material of the mathematics texts studied has been arbitrarily classified as generalizations, information, or language. The generalizations have been arranged under forty one main headings which have been alphabetically arranged. The language terms are to be found in appendix III at the end of the report. Material which appeared to have as its primary purpose the presentation of material rich in functional value related to the everyday life of the student, has been summarized under the heading Socialized Mathematics. In the case of this report no material from the Geometry or Algebra texts has been included under this heading although it is obvious that much of the material from both of these subjects could be included.

2. An effort has been made to indicate the point of view in the teaching of Mathematics in the various provinces as expressed by the text books and the programmes of study. In some provinces stress was placed on the application of the generalization with little emphasis on formal presentation. In other provinces it appeared that little or no attempt was made to present the practical application of the generalization and only the formal presentation was considered. In an effort to indicate this variation in the method of presentation the generalizations were classified under one of the following headings;

(a) assumed to be true, and used without explanation or statement.

(b) assumed to be true, but explained or stated informally.

(c) offered with a proof, or stated formally often with an explanation.

The number following the generalization in each of the first three columns on the right hand side of the page in this report indicates the number of texts which present that particular generalization in each of the three ways.

3. Many of the generalizations found at the Grade IX level in some provinces will be found at the Grade X level in other provinces or may even be reviewed in Grade X in that same province. For that reason it was considered useful to indicate the number of provinces which had presented the generalizations of the Grade X course in Grade IX. This has been done by the number in the fourth column on the right hand side of the page.

4. Both the texts and the course of study in each province were examined so that only material offered in the classrooms was tabulated. In the case of Quebec the material for both the Catholic and Protestant divisions was tabulated. In the case of Alberta the material from both Geometry 1 and the Algebra 1 course was tabulated since either of these courses may be taken by students in Grade X. The texts which were analyzed are listed by provinces in Appendix I. Notes made from the Programme of Studies are given in Appendix II.

5. The generalizations are listed under the main headings in the order of frequency, those occurring most frequently being listed first.

THE GENERALIZATIONS

1. Angles	(a)	(b)	(c)	(R)
(1) If two straight lines intersect, the vertically opposite angles are equal.	1	0	7	6
(2) The sum of the angles of a triangle is equal to two right angles.	1	0	6	7
(3) The exterior angle of a triangle is equal to the sum of the two interior and opposite angles.	1	0	6	5
(4) The sum of the angles of a quadrilateral is equal to four right angles.	1	0	6	4

(a) Assumed to be true, but used without explanation or statement.
(b) Assumed to be true, but explained or stated informally.
(c) Offered with a proof, or stated formally often with an explanation.
(R) Reviewed in grade X. Appears in the Grade IX summary the number of times listed.

		(a)	(b)	(c)	(R)
(5)	If a straight line stands on another straight line the sum of the angles so formed on one side of it is two right angles.	1	1	5	5
(6)	If two triangles have two angles of one equal respectively to two angles of the other, then the third angles are equal.	1	1	5	0
(7)	The sum of the exterior angles of a polygon is equal to four right angles.	0	0	6	3
(8)	The sum of the angles at a point is four right angles.	1	0	5	5
(9)	If the sum of two adjacent angles is equal to two right angles the exterior arms of the angle are in the same straight line.	0	1	5	5
(10)	The sum of the interior angles of a polygon is equal to 2n-4 right angles.	0	0	6	3
(11)	If one side of a triangle is produced then the exterior angle is greater than either one of the interior opposite angles.	0	0	5	3
(12)	Any two angles of a triangle are together less than two right angles.	0	0	5	2
(13)	Every triangle must have at least two acute angles.	0	0	5	2
(14)	Only one perpendicular can be drawn to a straight line from a point outside it.	0	0	5	0
(15)	If one angle of a triangle is equal to the sum of the other two the triangle is right angled.	0	0	5	3
(16)	The complements of equal angles are equal.	0	0	4	3
(17)	The supplements of equal angles are equal.	0	0	4	3
(18)	In any right triangle the two acute angles are complementary.	0	0	4	0

II. Angles in a Circle.

	(a)	(b)	(c)	(R)
(1) The angles at the centre of a circle is double the angle at the circumference standing on the same arc.	1	0	1	0
(2) Angles in the same segment of a circle are equal.	1	0	1	0
(3) The opposite angles of a quadrilateral inscribed in a circle are together equal to two right angles.	1	0	1	0
(4) The angle in a semicircle is a right angle.	1	0	1	0
(5) The angle in a segment greater than a semicircle is acute; and the angle in a segment less than a semicircle is obtuse.	1	0	1	0
(6) In equal circles, arcs which subtend equal angles, either at the centres or at the circumference,are equal.	0	0	1	0
(7) In equal circles, angles either at the centres or at the circumferences, which stand on equal arcs are equal.	0	0	1	0
(8) The angles which a tangent makes with a chord through its point of contact are equal to the angles in the alternate segments formed by the chord.	1	0	0	0
(9) The angles in the alternate segments of a circle are supplementary.	1	0	0	0
(10) The angle formed by a side and a diagonal of an inscribed quadrilateral is equal to the angle formed by the opposite side and the other diagonal.	1	0	0	0

III. Area. (see also Formula)

(1) The area of a parallelogram is the product of the base and the altitude.	1	1	5	7
(2) Triangles on the same base and between the same parallels are equal in area.	1	0	7	1
(3) The area of a triangle is equal to the product of half the base and the altitude.	2	1	4	6

	(a)	(b)	(c)	(R)
(4) Parallelograms on the same base and between the same parallels are equal in area.	1	0	5	1
(5) If a triangle and a parallelogram stand on the same base and between the same parallels, the area of the triangle is half that of the parallelogram.	0	0	5	1
(6) Parallelograms on equal bases in the same straight line and between the same parallels are equal in area.	0	0	4	1
(7) The area of any rectilineal figure can be found (on squared paper) by considering the figure to be made up of rectangles and right triangles.	1	0	2	0
(8) Equivalent triangles which have equal bases in the same straight line, and are on the same side of it, are between the same parallels.	1	0	2	0
(9) Triangles on equal bases and between the same parallels are equal in area.	0	0	3	0
(10) The area of any irregularly shaped field may be found by dividing it into triangles, trapezia, and rectangles. (land surveyor's method)	1	0	1	0
(11) If two triangles are equal in area and on the same side of the base then the line joining their vertices is parallel to the base.	0	0	2	0
(12) A median of a triangle bisects its area.	0	0	2	0
(13) The area of any right angled triangle may be found by regarding it as half a rectangle.	0	0	1	0
(14) The area of any curvilineal figure may be found by the method of counting squares.	0	0	1	0
(15) If a parallelogram and a rectangle are on the same base and between the same parallels they are equal in area.	0	0	1	0
(16) If the three sides of a triangle are given the area may be found by trigonometry.	1	0	0	0

IV. Axioms.

	(a)	(b)	(c)	(R)
(1) Through a given point only one straight line can be drawn parallel to a given straight line.	0	0	5	3
(2) If equals be added to equals the results are equals.	0	0	5	10
(3) If equals be subtracted from equals the results are equal.	0	0	5	10
(4) If equals be multiplied by equals the results are equal.	0	0	5	10
(5) If equals be divided by equals the results are equal.	0	0	5	10
(6) Things equal to the same thing are equal to one another.	0	0	5	4
(7) There can be only one straight line joining two given points.	0	0	4	2
(8) Every finite straight line has a point of bisection.	0	0	4	2
(9) A straight line may be drawn perpendicular to a given straight line from a point in it.	0	0	3	2
(10) Every angle may be supposed to have a line of bisection.	0	0	4	2
(11) The whole is equal to the sum of its parts.	0	0	1	2
(12) The whole is greater than any of its parts.	0	0	1	2

V. Circles.

(1) The straight line which bisects a chord at right angles passes through the centre of the circle.	1	0	1	0
(2) One circle and only one can pass through any three points not in a straight line.	1	0	1	1
(3) The tangent at any point of a circle is perpendicular to the radius drawn to the point of contact.	1	0	1	0

	(a)	(b)	(c)	(R)
(4) Two tangents can be drawn to a circle from an external point.	1	0	1	0
(5) If two circles touch each other the centres and the point of contact are in the same straight line.	1	0	1	0
(6) A circle is symmetrical about any diameter.	0	0	1	0
(7) Two circles are divided symmetrically by their line of centre.	0	0	1	0
(8) If two circles cut at one point, they must also cut at a second point; and the common chord is bisected at right angles by the lines of centres.	0	0	1	0
(9) If a straight line drawn from the centre of a circle bisects a chord which does not pass through the centre it cuts the chord at right angles.	0	0	1	0
(10) A straight line cannot meet a circle in more than two points.	0	0	1	0
(11) If from a point within a circle more than two equal straight lines can be drawn to the circumference, that point is the centre.	0	0	1	0
(12) Equal chords of a circle are equidistant from the centre.	0	0	1	0
(13) Chords which are equidistant from the centre are equal.	0	0	1	0
(14) Of any two chords of a circle, that which is nearer to the centre is greater than the one more remote.	0	0	1	0
(15) If from any internal point, not the centre, straight lines are drawn to the circumference of the circle, then the greatest is that which passes through the centre, and the least is the remaining part of the diameter. And of any other two such straight lines the greater is that which subtends the greater angle at the centre.	0	0	1	0

		(a)	(b)	(c)	(R)
(16)	If from any external point straight lines are drawn to the circumference of a circle the greatest is that which passes through the centre, and the least is that which produced passes through the centre. And of any other two such lines, the greater is that which subtends the greater angle at the centre.	0	0	1	0
(17)	In equal circles, arcs which are cut off by equal chords are equal, the major arc equal to the major arc, and the minor to the minor.	0	0	1	0
(18)	In equal circles chords which cut off equal chords are equal.	0	0	1	0
(19)	The angles made by a tangent to a circle with a chord drawn from the point of contact are respectively equal to the angles in the alternate segments of the circle.	0	0	1	0
(20)	If two circles touch the distance between the centres is (1) the sum of the radii when the contact is external, (2) the difference of the radii when the contact is internal.	1	0	1	0
(21)	Let the diagonals of the inscribed quadrilaterals intersect at T. Then the product of the corresponding segments of the diagonal are equal.	1	0	0	0
(22)	If a pair of opposite sides of an inscribed quadrilateral intersect, i.e. if SP and RQ intersect at X, then SP.PX equals RX.QX.	1	0	0	0

VI. <u>Constructions.</u>

		(a)	(b)	(c)	(R)
(1)	To bisect a given straight line.	1	0	7	8
(2)	From a given point in a straight to draw a perpendicular to the straight line.	1	0	7	8
(3)	From a point outside a line to drop a perpendicular to a given line.	1	0	7	8

Note; Three texts give three methods of carrying out constructions #2 and #3.

		(a)	(b)	(c)	(R)
(4)	To bisect a given angle.	1	0	7	7
(5)	Through a given point to draw a straight line parallel to a given straight line.	1	0	7	8
(6)	At a point to make an angle equal to a given angle.	1	0	6	8
(7)	To construct a triangle given three sides.	0	0	6	7
(8)	To divide a given straight line into any given number of parts.	0	0	6	6
(9)	To construct a triangle given two sides and an angle, not included.	1	0	4	3
(10)	To construct a right-angled triangle given the hypotenuse and one side.	1	0	4	3
(11)	To construct a square on a given side.	0	0	5	4
(12)	To construct a parallelogram having given two adjacent sides and the included angle.	0	0	4	3
(13)	To construct a quadrilateral given the lengths of the four sides and one angle.	0	0	4	3
(14)	To construct a triangle equivalent to a given quadrilateral.	1	0	3	1
(15)	To construct a parallelogram equal in area to a given triangle and having an angle equal to a given angle.	0	0	2	0
(16)	To draw a tangent to a circle from a given external point.	1	0	1	0
(17)	To construct a triangle given two sides and the included angle.	1	0	0	6
(18)	To construct a triangle given one side and two angles.	1	0	0	6
(19)	To construct a triangle equal in area to a given triangle, and having its base of a given length.	0	0	1	0

		(a)	(b)	(c)	(R)
(20)	To draw squares whose areas shall be respectively twice, three times, four times,..........that of a given square.	0	0	1	0
(21)	To draw a parallelogram equal in area to a given rectilineal figure and having an angle equal to a given angle.	0	0	1	0
(22)	Given a circle, or an arc of a circle to find its centre.	0	0	1	2
(23)	To draw a common tangent to two given circles.	0	0	1	0
(24)	On a given straight line to describe a segment of a circle which shall contain an angle equal to a given angle.	0	0	1	0
(25)	To cut off from a given circle a segment containing an angle equal to a given angle.	0	0	1	0
(26)	To circumscribe a circle about a given triangle.	0	0	1	1
(27)	To inscribe a circle in a given triangle.	0	0	1	1
(28)	To draw an escribed circle of a given triangle.	0	0	1	0
(29)	In a given circle to inscribe a triangle equiangular to a given triangle.	0	0	1	0
(30)	About a given circle to circumscribe a triangle equiangular to a given triangle.	0	0	1	0
(31)	To bisect a given arc.	0	0	1	0
(32)	To draw a tangent to a circle at a point on a circle.	1	0	0	0
(33)	To inscribe a circle in a given triangle.	1	0	0	0
(34)	To circumscribe a regular polygon about a circle.	1	0	0	0
(35)	To construct a triangle equal to a given rectilineal figure.	0	0	1	0

VII. Divisions of a Straight Line.	(a)	(b)	(c)	(R)
(1) If there are three or more parallel straight lines, and the intercepts made by them on any one straight line that cuts them are equal, then the corresponding intercepts on any other straight line that cuts them are also equal.	0	0	5	2
(2) The straight line drawn through the middle point of one side of a triangle parallel to another side bisects the third side.	1	0	3	3
(3) The straight line joining the middle points of a triangle is parallel to the third side and equal to half of it.	1	0	3	3

VIII. Divisibility Tests.				
(1) All even numbers are divisible by two.	0	0	1	1
(2) A number is divisible by three when the sum of its digits is divisible by three.	0	0	1	1
(3) A number is divisible by four when the two right hand digits are zero, or when the number expressed by its two right-hand digits is divisible by four.	0	0	1	1
(4) A number is divisible by five if its right hand digit is zero or five.	0	0	1	1
(5) A number is divisible by six if it is an even number and the sum of its digits is divisible by three.	0	0	1	0
(6) A number is divisible by eight if the three right hand digits are zeros, or if the number expressed by its three right hand digits is divisible by eight.	0	0	1	0
(7) A number is divisible by nine when the sum of its digits is divisible by nine.	0	0	1	0
(8) A number is divisible by ten if its right digit is zero.	0	0	1	0

	(a)	(b)	(c)	(R)
(9) A number is divisible by eleven when the sum of the digits in the odd places is equal to the sum of the digits in the even places, or when the difference between these sums is eleven or a multiple of eleven.	0	0	1	0
(10) A number is divisible by 12 when it is divisible by both three and four.	0	0	1	0

IX. <u>Evaluation.</u>

	(a)	(b)	(c)	(R)
(1) Evaluation is the process of putting a number in place of a letter in a given algebraic expression and thus finding a corresponding numerical value.	1	0	1	8

X. <u>Equations.</u>

	(a)	(b)	(c)	(R)
(1) An equation may be cleared of fractions by multiplying both members of the equation by a number that contains each of the denominators as one of its factors.	1	2	5	0
(2) Literal equations may be solved by applying the same methods as are used in numerical equations.	1	3	4	0
(3) Solving simultaneous equations containing two unknowns by elimination by addition or subtraction.	4	2	2	5
(4) Solving simultaneous equations by elimination by substitution.	0	3	3	3
(5) To solve simple equations of one unknown; if necessary clear of fractions and remove brackets. Transpose all the terms containing the unknown to one side and the known quantities to the other. Collect the terms on each side; divide both sides by the coefficient of the unknown quantity and the value required is obtained.	5	0	2	9
(6) A term may be dropped from either member of an equation, provided the corresponding opposite term is written in the other member.	0	0	6	8

	(a)	(b)	(c)	(R)
(7) Simultaneous equations involving two unknowns may be solved by drawing the graph of each function and reading the co-ordinates of their point of intersection.	1	3	2	3
(8) Quadratic equations may be solved by factoring or by the square root method.	0	4	2	4
(9) If equals are increased, or decreased, or multiplied, or divided by equals the result are equals	0	0	5	10
(10) Solving sets of equations containing three unknowns by elimination.	0	4	1	1
(11) Multiplying or dividing each member of an equation by minus one changes the sign of each term in the given equation.	0	1	3	2
(12) The quadratic equation $ax^2 + bx + c = k$ may be solved graphically by drawing the parabola representing the left side and then drawing the graph of the line $y=k$. The abscissas of the intersection points of the graphs are the roots of the equation.	1	0	2	0
(13) An equation of the first degree in one unknown is one where (a) the unknown appears only with the exponent one; (b) the unknown does not appear in the denominator when the equation is written in its simplest form.	0	0	2	1
(14) Members of an equation may be interchanged.	1	0	1	0
(15) Parentheses may be removed by following the rule of distribution for multiplication.	0	0	2	0
(16) To solve a set of equations by the method of determinants. Arrange the equation in the form $ax + by = c$, $dx + ey = f$. There is a common solution if <u>ae-bd</u> is not zero. The value of <u>x</u> is the fraction formed by taking as a denominator the determinant formed by the coefficients of <u>x</u> and <u>y</u>, and its numerator is the determinant formed by replacing the coefficients of <u>x</u> by the corresponding absolute terms. The value of <u>y</u> is a fraction with the same denominator as <u>x</u>; its numerator is the	0	0	2	0

	(a)	(b)	(c)	(R)
determinant obtained by replacing the coefficients of y in the denominator determinant by the absolute terms.				
Note: This is optional in one of the texts in which it is given.				
(17) Equations in one unknown, of the second degree or a higher degree may be solved by transforming the equation so that the right member is zero. Factor the left member completely and set each factor which contains the unknown to zero.	0	0	2	4
(18) Solving quadratic equations by the method of completing the square.	0	0	2	0
(19) Quadratic equations may be solved by using the quadratic formula; $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	0	0	2	0
(20) In a quadratic equation where the coefficient of x^2 is 1; (a) the sum of the roots is equal to the coefficient of x with its sign changed. (b) the product of the roots is equal to the constant term.	0	0	2	0
(21) In a quadratic equation the character of the roots may be determined by the use of the discriminant $b^2 - 4ac$.	0	0	2	0
(22) Solving fractional equations containing two equal fractions by the method of cross-multiplication.	0	0	2	0
(23) Verifying equations by substitution.	0	2	0	0
(24) Solving a radical equation by transposing and squaring both sides.	2	0	0	0
(25) Solving equations by the method of elimination by comparison.	0	1	0	1
(26) Solving simple exponential equations by the use of logarithms.	0	0	1	0
(27) The equation of a circle with its centre at the origin is $x^2+y^2=r^2$	0	0	1	0
(28) The equation of an ellipse is $ax^2+by^2=c$ (where a, b, c all have the same sign.)	0	0	1	0

XI. Factoring.	(a)	(b)	(c)	(R)
(1) Factoring the sum and difference of cubes.	0	0	9	2
(2) Factoring the product of a polynomial and a monomial. ($mb+mc$)	0	8	0	8
(3) Factoring a trinomial of the form ax^2+bx+c:				
(a) by inspection.	0	8	0	7
(b) factoring trinomials which are perfect squares.	0	4	1	0
In two instances the method of decomposition and the method of cross-multiplication were explained.				
(4) The factors of the difference of two squares equals the product of the sum and difference of their square roots.	0	0	8	8
(5) The factor theorem. If any polynomial in x becomes zero when n is substituted for x then $x-n$ is a factor of the polynomial.	0	0	5	2
(6) Factoring an incomplete square, by completing the square.	0	4	0	2
(7) Finding the prime factors of the expression: Remove any monomial factors of the expression. Then factor the polynomial expression. Continue until all factors are prime.	0	1	2	0

XII. Fractions				
(1) Reducing fractions. Divide both terms by all their common factors.	1	0	8	7
(2) Multiplication of fractions. Cancel fractions common to a numerator and a denominator. Multiply the remaining factors of the numerators for the numerator of the product, and of the denominators for the denominator of the product.	5	0	4	9
(3) Signs of fractions. If the sign of either the numerator or the denominator of a fraction is				

		(a)	(b)	(c)	(R)
	changed, the sign of the fraction also must be changed; but if signs of both the numerator and denominator are changed, the sign of the fraction is not changed.	0	0	9	1
(4)	Addition and Subtraction of Fractions. Change the fractions to equivalent fractions having similar denominators. Combine the numerators obtained. Simplify by reduction.	0	0	8	9
(5)	The numerator and denominator of a fraction can be multiplied or divided by the same number (zero excepted) without changing the value of the fraction.	0	0	8	9
(6)	Division of Fractions. Invert the divisor fraction. Multiply the dividend by the inverted divisor.	1	0	3	9
(7)	In adding or subtracting fractions having an L.C.D. with three factors such as (a-b) (b-c) (c-d) it is advisable to write the factors in cyclic order.	0	0	4	0
(8)	The common denominator of two or more fractions must contain each of the given denominators as an exact divisor.	0	0	1	0
(9)	An improper number may be expressed as a whole or a mixed number.	0	1	0	0
(10)	Vulgar fractions may be expressed as a decimal fraction.	0	1	0	0
(11)	Decimal fractions may be added.	0	1	0	0
(12)	Decimal fractions may be subtracted.	0	1	0	0
(13)	Decimal fractions may be multiplied.	0	1	0	0
(14)	Decimal fractions may be divided.	0	1	0	0
(15)	The use of aliquot parts in multiplication and division of percentages.	0	1	0	0
(16)	To change two or more fractions to respectively equivalent fractions, divide each of the denominators of the given fraction into the L.C.D. and multiply the quotient by the respective numerator.	1	0	1	0

XIII. Functions.	(a)	(b)	(c)	(R)
(1) If two variables such as x and y are so related that to each value of x there corresponds a definite value or set of values for y then y is called a function of x.	0	0	3	0
(2) Functional relations may be expressed in four ways; expressed by words expressed by formula expressed by a table of values expressed by a graph	0	0	3	5

XIV. Fundamental Operations.

A. Sequence of Numerical Operations. Perform first the indicated operations of the third order, then those of the second order, and finally those of the first order.	0	0	3	3

Note: No mention is made of involution in one of the texts above.

B. Rules of Addition.

(1) To add two signed numbers having like signs, find the sum of their absolute values and prefix to this sum their common sign.	2	0	3	9
(2) Law of Order. (commutative) In addition the addends may be combined in any order.	0	0	5	0
(3) To add similar terms, find the algebraic sum of the coefficients and multiply it by the common literal factor.	0	0	4	8
(4) To add two signed numbers having unlike signs find the difference between their absolute values and prefix to it the sign of the number which has the greater absolute value.	2	0	2	9
(5) Law of Grouping. (Association) In addition the addends may be grouped in any manner.	0	0	2	4

	(a)	(b)	(c)	(R)
C. <u>Rules of Subtraction.</u>				
(1) To subtract one signed number from another we may change the sign mentally and then proceed as in addition.	1	0	5	9
(2) To subtract a term from one which is similar to it, mentally change the sign of the subtrahend and proceed as in addition.	1	0	3	9
(3) Law of order (Commutative) Subtractions may be made in any order.	0	0	1	0
(4) In subtraction the terms of an expression may be grouped in any manner.	0	0	1	0
D. <u>Rules of Multiplication.</u>				
(1) Multiplication of polynomial by a polynomial. Each term of the first polynomial must be multiplied by each term of the second and the partial products must then be combined.	1	0	5	8
(2) To multiply one signed number by another, find the product of their absolute value, making the results positive if the two numbers have like signs and negative if they have unlike signs.	2	0	3	9
(3) In multiplication the factors may be combined in any order. Law of Order. (Commutative)	0	0	5	
(4) Law of Grouping (Associative) In multiplication the factors may be grouped in any order.	0	0	4	
(5) Law of Distribution. To multiply a polynomial by a monomial multiply each term of the polynomial by the monomial, uniting the resulting terms by their proper signs.	0	0	4	

	(a)	(b)	(c)	(R)
(6) Law of Exponents. The exponent of the product of the powers having like bases is the sum of the original exponents.	0	0	4	9
(7) Multiplication of Monomials. Find The product of their numerical coefficients. Multiply this by the product of the literal factors.	1	0	3	9
(8) Multiplication of two compound expressions by detached coefficients.	0	4	0	2
(9) Multiplication may be indicated by the use of the parentheses.	2	0	1	0
(10) Short Methods of Multiplication. (a) In multiplying by 10, 100 etc. it is only necessary to add one two .....zeros. (b) By the method of aliquot parts. (c) Using cross multiplication.	0	0	1	0

E. Rules of Division.

	(a)	(b)	(c)	(R)
(1) Division of Polynomial by Polynomial. 1. Arrange terms of dividend and divisor according to ascending or descending powers of the same letter. 2. Divide first term of the dividend by the first term of the divisor to obtain the first term of the quotient. 3. Multiply the divisor by the term of the quotient just found and subtract the product from the dividend to obtain a new dividend. 4. Repeat steps two and three until there is no remainder or until in the remainder the exponent of the letter upon which the arrangement is based is less than the largest exponent it has in the divisor.	0	3	4	6
(2) Division by the method of detached coefficients.	0	4	0	2
(3) Law of Distribution. To divide a polynomial by a monomial divide each term of the polynomial by the monomial uniting the resulting terms by their proper signs.	0	0	5	9
(4) Law of Exponents. The exponent of the quotient of powers having like bases is found by subtracting the exponent of the divisor from that of the dividend.	0	0	5	9

	(a)	(b)	(c)	(R)
(5) If two algebraic numbers have like signs, their quotient is positive, but if they have unlike signs their quotient is negative.	0	1	2	9
(6) To divide any algebraic expression by a monomial divide each term of the dividend by the divisor uniting the resulting terms by their proper signs.	0	0	2	9
(7) Division by zero is impossible.	0	0	1	3
(8) To divide monomial by monomial find the quotient of their numerical coefficients then use the law of exponents for division of the literal factors.				
(9) Remainder Theorem. If any rational integral function of x is divided by x-a until the remainder does not contain x the remainder is a function of a.	0	0	1	0
(10) Division of algebraic terms may be verified by substituting an Arithmetical value for the variable.	0	1	0	0
(11) Short division in Arithmetic.	0	1	0	0
(12) Long division in Arithmetic.	0	1	0	0
(13) Short methods of dividing by 10, 100, 1000, ... and by 25, 50, 75 ..... etc.	0	1	0	0

XV. Formulas.

	(a)	(b)	(c)	(R)
(1) When a formula is given, the value of any one of the variables may be found in terms of the other variables.	1	0	3	0
(2) Linear formulas.				
(a) Circumference of a circle; $2\pi r$.	2	0	0	7
(b) Distance a moving object travels in t seconds at v m. p. h.; $S=vt$.	1	0	0	0
(c) Distance a falling body falls in t seconds is; $S=\frac{1}{2}gt$	1	0	0	0

	(a)	(b)	(c)	(R)
(d) Length of a sector of a circle, if angle at centre is 2a; $\frac{\pi ar}{90}$	1	0	0	0
(e) Length of a chord of a circle if angle at centre is 2a; $L=2r \sin a$	1	0	0	0
(f) If length of chord is 2l and the distance from the centre is d then; $l^2+d^2=r^2$	1	0	0	0
(g) Distance from centre of chord, if angle 2a; $d=r\cos a$	1	0	0	0
(h) Length of perpendicular from vertex to longest side; $p^2=c^2-(a-x)^2$ where a and c are sides of the triangle and x is one of the segments marked off the base by the perpendicular.	1	0	0	0
(i) The sum of the squares of two sides (a and b) of a triangle equals twice the square of one half the thirdside (c) increased by twice the square of the median (m) drawn to that side; $a^2+b^2=2(\frac{c}{2})^2+2m^2$	2	0	0	0

(3) <u>Area Formula.</u> (See also heading Area)

	(a)	(b)	(c)	(R)
(1) Area of a circle; $A=\pi r^2$	5	0	0	6
(2) Area of a trapezium; $A=\frac{1}{2}$(sum of parallel sides) x (distance between them.)	4	0	1	7
(3) Surface area of a sphere; $A=4\pi r^2$	4	0	0	3
(4) Area of a triangle; $A=\frac{1}{2}bh.$	3	0	0	6
(5) Area of a triangle given the sides a, b, c. $A= s(s-a)(s-b)(s-c)$ when $2s=a+b+c.$	0	0	2	3
(6) Area of a sector of a circle with central angle 2a; $A=\frac{a\pi r^2}{180}$	2	0	0	0

	(a)	(b)	(c)	(R)
(7) Area of a parallelogram: $A=ba$.	1	0	0	7
(8) Area of a quadrilateral: $A=\frac{1}{2}$ diagonal x (sum of offsets)	0	0	1	1
(9) Segment area of segment with chord of 21: $A= r(\frac{a}{180} - \sin \underline{a} \cos \underline{a})$	1	0	0	0
(10) The area of a triangle with its base on the chord of a circle and its vertex at the centre: $ld=r^2 \sin a \cos a$ if $2\underline{l}$ is the chord, d the distance of chord from centre and 2a is the central angle.	1	0	0	0
(11) Lateral surface area of prism or cylinder: $A=ps$	1	0	0	0
(12) Lateral area of regular pyramid: $A= \frac{1}{2}ps$	1	0	0	0
(13) Lateral area of regular circular cone: $A=\pi rs$	1	0	0	0
(14) Lateral area of frustrum of regular pyramid: $A= \frac{1}{2}(p_1+p_2)s$	1	0	0	0
(15) Lateral area of frustrum of right circular cone: $A=\pi(r_1+r_2)s$	1	0	0	0
(16) Area of spherical belt of sphere $A= 2\pi rh$	1	0	0	0
(17) Area of sector of circle with arcequals $\underline{a}$ is $A=\frac{1}{2}ar$	0	0	1	0

(4) Volume Formulas.

	(a)	(b)	(c)	(R)
(1) Volume of a right pyramid or right cone; $V=1/3bh$	3	0	0	4
(2) Volume of a sphere; $V=4/3\pi r^3$	3	0	0	4
(3) Volume of a pyramid; $V=1/3$ area of base (height)	1	0	0	4

	(a)	(b)	(c)	(R)
(4) Volume of frustrum of regular pyramid: $V=1/3(b_1+b_2+\sqrt{bb})h$	1	0	0	0
(5) Volume of prism or cylinder: $V=bh$.	1	0	0	3
(5) Miscellaneous Formulas.				
(1) The amount to which P dollars accumulates at r% compounded annually for <u>n</u> years: $S= P(1+r)^n$	2	0	0	1
(2) The sum of the squares of two sides of the triangle equals twice the square of one half the third side increased by twice the square of the median drawn to that side.	2	0	0	0
XVI. <u>Graphs.</u>				
(1) Plotting a graph by the "table of values method."	6	2	0	0
(2) The graph of an equation of the type $y=mx$ is a straight line and such an equation is called a linear equation.	0	0	8	2
(3) Statistical data may be represented by various types of graphs: (bar, circle, broken line, straight line, curved line)	7	0	0	7
(4) A point may be located on a graph by giving its position with respect to the axes.	0	6	1	0
(5) A pair of simultaneous equations may be solved graphically by drawing the equation of each line and finding the co-ordinates of the point where the two lines cross. (See also equations.)	0	6	0	0
(6) In the equation $y=mx+b$ the slope of its graph is the coefficient of <u>x</u>, i.e. "<u>m</u>"; and the y-intercept is "<u>b</u>".	0	2	2	0
(7) An equation which contains only one of the variables x and y represents a line parallel to one of the axes.	3	0	0	0

	(a)	(b)	(c)	(R)
(8) The slope of straight line is the ratio of its "<u>rise</u>" over its "<u>run</u>".	1	1	0	0
(9) The graphs of linear equation may be drawn by joining the x- and y-intercepts.	0	2	0	0
(10) Graphs of linear equations may be drawn by the use of "slope" and "intercept method."	1	0	1	0
(11) The formula for a straight line graph may be derived from a graph by substituting values of x and y in the equation $y=mx+b$ and solving for m and b.	0	2	0	0
(12) The graph of a function of the type x^2 is a curve symmetrical about the y-axis.	0	2	0	0
(13) The graph of a function of the type ax^2+c is a parabola symmetrical about the y-axis and cutting the y-axis at "C".	0	2	0	0
(14) The slope of a straight line is the same throughout its entire length.	0	0	1	0
(15) The graph of a function of the type $(x+a)^2$ is symmetrical about the line $x=-a$.	0	1	0	0
(16) In the function ax^2+bx+c the graph of such a function is a parabola. The graph turns upward when "a" is positive, and downward when "a" is negative.	0	0	1	0
(17) The graph of the function $x^2+y^2=r^2$ is a circle with radius "r" and centre at the origin.	0	0	1	0
(18) The graph of the function $ax^2+by^2=c^2$ is an ellipse with its centre at the origin.	0	0	1	0

XVII. Highest Common Factor.

	(a)	(b)	(c)	(R)
(1) Finding the H.C.F. of algebraic expressions by finding the product of the common factors.	0	5	0	0

	(a)	(b)	(c)	(R)
(2) Finding the H.C.F. of algebraic expressions by the Division Method, based on the following principles; (a) If an expression contains a certain factor any multiple of the expression is divisible by that factor. (b) If two expressions have a common factor it will divide their sum and difference, or the sum and difference of any multiple of them.	0	0	5	1

Note: The Grade IX summary shows the following: The H.C.F. of any two numbers is a factor of their difference.

XVIII. Inequalities.

(1) If two angles of a triangle are unequal, the greater angle has the greater side opposite to it.	1	1	6	3
(2) If two sides of a triangle are unequal the greater side has the greater angle opposite to it.	1	0	6	3
(3) Any two sides of a triangle are together greater than the third.	1	0	6	2
(4) Of all the straight lines that can be drawn to a given straight line from a given point outside it, the perpendicular is the shortest.	0	0	4	0
(5) If two triangles have two sides of one equal to two sides of the other, each to each: and the third sides unequal, the triangle which has the greater third side has the greater included angle.	0	0	2	0

XIX. Illustration of Algebraic Indentities.

(1) Geometrical illustration of the following identities:	0	0	1	0

$(a+b)k=ak+bk$
$(a+b)\ (c+d)=ac+bc+ad+bk$
$(a+b)^2=a^2+b^2+2ab$
$(a-b)^2=a^2+b^2-2ab$
$(a^2-b^2=(a-b)\ (a+b)$

	(a)	(b)	(c)	(R)
XX. Least Common Multiple.				
(1) Finding the L.C.M. of simple expressions by inspection.	0	2	0	0
(2) Finding the L.C.M. of compound expressions by factoring and inspection.	0	6	0	0
(3) Finding the L.C.M. of two expressions by dividing their products of their H.C.F.	0	0	3	0
XXI. Loci.				
(1) The locus of a point equidistant from two fixed points is the perpendicular bisector of the straight line joining the two fixed points.	1	0	4	2
(2) The locus of a point which is equidistant from two intersecting straight lines consists of the pair of straight lines which bisects the angles between the two given lines.	1	0	4	1
(3) The locus of points on one side of a given straight line and at a given distance from that line is a straight line parallel to the given line, through any point at the given distance from the given line.	0	0	1	0
(4) Given the base and vertical angle of a triangle, to find the locus of its orthocentre.	0	0	1	0
(5) Given the base and the vertical angle of a triangle, find the locus of the in-centre.	0	0	1	0
XXII. Logarithms.				
(1) The method of logarithms is based on the ordinary laws of exponents.	0	0	1	0
(2) The logarithm of number "n" to the base "a" is the exponent of the power to which the base "a" must be raised to produce "n".	0	0	1	0

	(a)	(b)	(c)	(R)
(3) Common logarithms have 10 as their base.	0	0	1	0
(4) The integral part of a logarithm is called its characteristic and the decimal part is its mantissa.	0	0	1	0
(5) The characteristic of the logarithm of a number greater than 1 is positive and is one less than the number of integral places in the number.	0	0	1	0
(6) The characteristic of the logarithm of a number between zero and one is negative, and is numerically one more than the number of zeroes immediately following the decimal.	0	0	1	0
(7) Numbers which have the same figures in the same order and differ only in the position of the decimal point have the same mantissa in their logarithms.	0	0	1	0
(8) The mantissa of the logarithms of a number containing four or more significant figures is found by interpolation.	0	1	0	0
(9) The logarithm of a product equals the sum of the logarithms of its factors.	0	0	1	0
(10) The logarithm of a power of a number equals the logarithm of the number multiplied by the exponent of the power.	0	0	1	0
(11) The logarithm of a root of a number equals the logarithm of the number divided by the index of the root.	0	0	1	0
(12) The logarithm of a quotient equals the difference between the logarithm of the dividend and the logarithm of the divisor.	0	0	1	0

Note: The section dealing with logarithms is marked optional in the only course in which it is presented.

		(a)	(b)	(c)	(R)
XXIII.	Mensuration. (See Formulas)				
	Textbooks from two provinces presented material that would normal ly be classified under this heading but all such material has been classified under Formulas, or under other appropriate headings.				
XXIV.	Parallels.				
	(1) When a transversal cuts two other straight lines, the two straight lines are parallel if:				
	(a) A pair of corresponding angles are equal.	1	0	6	8
	(b) A pair of alternate angles are equal.	1	0	7	8
	(c) A pair of interior angles on the same side of the transversal are equal to two right angles.	1	0	6	8
	(2) If a straight line cuts two straight parallel lines:				
	(a) Alternate angles are equal.	1	0	7	8
	(b) Corresponding angles are equal.	1	0	5	8
	(c) Interior angles on the same side of the transversal together equal two right angles.	1	0	7	8
	(3) Straight lines which are parallel to the same straight line are parallel to one another.	0	0	4	2
	(4) The straight line which join the extremities of equal and parallel straight lines are themselves equal and parallel.	0	0	4	0
	(5) If each of two straight lines is perpendicular to a third straight line, the two straight lines are parallel.	0	0	1	4
	(6) If straight lines are drawn from a point parallel to the arms of an angle, the angle between those straight lines is equal or supplementary to the given angle.	0	0	1	0

	(a)	(b)	(c)	(R)
(7) If there are three or more parallel straight lines, and the intercepts made by them on any transversal are equal, then the corresponding intercepts on any other transversal are also equal.	0	0	1	2
(8) In a triangle, if a set of lines drawn parallel to the base divide one side into equal parts, they also divide the other side into equal parts.	0	0	1	1
XXV. Parallelograms.				
(1) Each diagonal bisects the parallelogram.	1	0	7	6
(2) The opposite angles of a parallelogram are equal.	1	0	6	3
(3) The opposite sides of a parallelogram are equal.	1	0	6	7
(4) The diagonals of a parallelogram bisect one another.	0	0	7	6
(5) A quadrilateral is a parallelogram if:				
(a) Both pairs of opposite angles are equal.	1	1	2	3
(b) If one pair of opposite sides are equal and parallel.	1	1	2	1
(c) If both pair of opposite sides are equal.	1	1	2	3
(d) If its diagonals bisect one another.	1	1	2	4
(6) The complements of the parallelograms about the diagonals of a parallelogram are equal.	1	0	1	0
(7) If two straight lines are parallel, all points on either line are equidistant from the other.	0	0	1	0
(8) If a parallelogram has one of its angles a right angle, all its angles must be right angles.	0	0	4	4

	(a)	(b)	(c)	(R)
(9) If one pair of adjacent sides of a parallelogram are equal, all of its sides are equal.	0	0	1	1
(10) All sides of a square are equal; and all its angles are right angles.	0	0	1	0

XXVI. Parentheses.

	(a)	(b)	(c)	(R)
(1) Removing Parentheses.				
(a) Apply the rule of signs for multiplication; thus $4(x+y+z)=4x+4y+4z$ When parentheses to be removed are preceded by plus signs the signs within the bracket remain unchanged; but when preceded by a minus sign the signs within the brackets must be changed.	0	0	7	9
(b) Parentheses without an indicated coefficient have a coefficient of one.	2	0	1	5
(c) In case of parentheses within other parentheses, remove one set at a time starting with the innermost.	1	1	2	5
(d) The proper order of operations must be followed; $10-3(c+3d)$ is not equal to $7(c+3d)$	0	0	1	0
(2) Inserting Parentheses. A set of terms may be enclosed in parentheses preceded by a plus sign without changing the signs; but when they are enclosed in parentheses preceded by a minus sign, the sign of each term so enclosed must be changed to the opposite sign.	1	1	6	0
(3) Collecting coefficients, of particular letters.	2	0	0	0

XXVII. Postulates.	(a)	(b)	(c)	(R)
(1) A straight line may be drawn from any one point to any other point.	0	0	4	3
(2) A finite straight line may be produced to any length.	0	0	4	3
(3) A circle may be drawn with any point as centre.	0	0	4	3
XXVIII. Products.				
(1) Product of two binomials. The first term is the product of the first terms of the binomials. The second term is found by combining the product of the two outer terms and that of the two inner terms. The third term is the product of the last two terms of the binomials.	0	0	4	0
(2) Square of a binomial. Is equal to the square of the first term, plus (or minus) twice the product of its two terms, plus the square of its second term.	1	0	4	0
(3) The product of the sum and difference of the same two numbers equals the difference of their squares.	0	0	5	0
(4) Square of a trinomial. The square of a trinomial is equal to the sum of the squares of the terms, together with the sum of twice the products of the terms taken in pairs.	0	3	1	0
(5) The product of two quantities is equal to the product of their H.C.F. and their L.C.M.	0	0	2	0
(6) Cube of a binomial. Is equal to the cube of the first term plus three times the product of the square of the first by the second, plus three times the first by the square of the second, plus the cube of the second number.	0	0	1	0

	(a)	(b)	(c)	(R)
XXIX. **Problem-Solving.**				
(1) Steps in problem-solving by the use of algebraic equations. (a) Read the problem and discover what is required. (b) Express the unknown quantity by a single letter. (c) Set up an equation containing the unknown. (d) Solve the equation. (e) Check the results.	1	6	2	0
XXX. **Projections.**				
(1) Projections on the same straight line of equal and parallel straight lines are equal.	0	1	0	0
XXXI. **Powers.**				
(1) Multiplication law for like bases. The product of two or more powers having the same base is equal to a power of that base whose exponent is the sum of the exponents of the given powers.	0	0	4	9
(2) The power of a power $(a^m)^n = a^{mn}$	0	1	1	0
(3) Division law for like bases The quotient of two powers having like bases is equal to a power of that base whose exponent is the difference of the exponents of the given powers.	0	1	0	9
(4) Multiplication law for like exponents. The product of two or more like powers having unlike bases is equal to the product of the bases to the given power.	0	1	0	0
(5) Division law for like exponents. The quotient of two like powers having unlike bases is equal to the quotient obtained by dividing one base by the other, to the given powers.	0	1	0	0

	(a)	(b)	(c)	(R)
(6) Any power having a zero exponent equals one.	0	0	1	1
(7) Any quantity with a negative exponent is equal to the reciprocal of that quantity with the corresponding positive exponent.	0	0	1	0
(8) In a fractional exponent the numerator indicates the power to which the base is to be raised , while the denominator indicates the root which is to be found.	0	0	1	0
(9) If two quantities are equal, their corresponding powers are equal.	0	0	1	0
(10) The square of every expression whether, such expression is positive or negative, is positive.	0	0	1	0
(11) No even power of any expression can be negative.	0	0	1	0
(12) Any odd power of an expression will have the same sign as the expression itself.	0	0	1	0
XXXII. <u>Percentage.</u>				
(1) Finding a given percentage of a number, by changing the percent to a fraction or a decimal fraction and multiplying it by the number.	0	1	0	5
(2) Finding what percent one number is of another, by finding what fractional part one number is of another, and changing this to a decimal fraction and then to a percent.	0	1	0	5
(3) Finding a number when a percentage of it is given.	0	1	0	5
XXXIII. <u>Ratio and Proportion.</u>				
(1) A ratio represents an indicated division. The principles that apply to fractions apply likewise to ratios.	0	0	2	2
(2) Rule of proportion. In a proportion the product of the extremes equals the product of the means.	1	0	1	1

Roots.	(a)	(b)	(c)	(R)
(1) An indicated root may be expressed as a radical.	0	3	3	0
(2) Finding square root of numbers by the square root method. (Arith.)	0	1	2	5
(3) Finding square root of a quantity by the use of a square root table.	1	1	1	5
(4) Finding square root by use of a graph.	0	2	0	0
(5) In rationalizing the denominator of a radical involving fractions, simplify it in such a way that the radicand is an integer, and the radical appears only in the numerator.	0	1	2	0
(6) Only similar radicals can be combined by addition or subtraction.	1	1	1	0
(7) Any even root of a positive quantity will have the double sign.	0	0	3	0
(8) Polynomials involving radicals may be multiplied and divided.	0	2	0	0
(9) The quotient of two radicals of the same order is equivalent to the like root of the quotient formed by dividing the one by the other; $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$	0	0	2	0
(10) Any indicated root of a product is equivalent to the product of the like roots of its factors.	0	0	2	0
(11) Finding the square root of an algebraic expression by the formal method as used in Arithmetic.	0	0	2	0
(12) When a root is raised to the power expressed by the index, the result must be equal to the radicand.	0	0	1	0
(13) The product of two radicals of the same order is equivalent to the like root of the product of their radicands.	1	0	1	0

	(a)	(b)	(c)	(R)
(14) Finding square root of an expression by the method of factoring and grouping the factors.	1	0	0	0
(15) No negative quantity can have an even root.	0	0	1	0
(16) Every odd root of a quantity has the same sign as the quantity itself.	0	0	1	0
(17) Extracting the roots of a simple expression. Find the index of each literal factor by dividing its index by the index of the root required. Find the required root of the arithmetical coefficient by arithmetic and prefix with proper sign to the literal expression already obtained.	0	0	1	0
(18) The square root of any trinomial which is a perfect square may be written down by inspection.	0	0	1	3
(19) The cube root of any power of a literal expression is obtained by dividing the index of the power by three.	0	0	1	0
(20) The cube root of an expression of four terms which is known to be a perfect cube is found by taking the cube root of the first and last terms.	0	0	1	0
(21) The fourth root of an expression may be found by taking the square root of the expression and then taking the square root of the result.	0	0	1	0

XXXV. "Rounding Off" Numbers.

	(a)	(b)	(c)	(R)
(1) (a) If the figure which is dropped is greater than five the preceding figure should be increased by one. (b) If the figure which is dropped is less than five, the preceding figure remains unchanged. (c) If the figure which is dropped is five the preceding figure is increased by one when it is odd but remains unchanged when it is even or zero.	0	0	4	0

		(a)	(b)	(c)	(R)
XXXVI. Scale Drawing.					
(1)	The drawing of triangles and other designated figures to scale.	2	0	0	4
(2)	The use of scale drawing to solve problems.	4	0	0	0
XXXVII. Squares. (See also Illustrations of Algebraic Identities.)					
(1)	The square on the sum of two straight lines is equal to the sum of the squares on the two lines increased by twice the rectangle contained by them.	0	0	1	0
(2)	The square on the difference of two straight lines is equal to the sum of the squares on the lines, diminished by twice the rectangle contained by them.	0	0	1	0
(3)	The difference of the squares on two straight lines is equal to the rectangle contained by the sum and the difference of the two lines.	0	0	1	0

Note: the generalizations re Squares are found only in one province that indicated by the letter C.

		(a)	(b)	(c)	(R)
XXXVIII. Similar Figures.					
(1)	If two triangles are similar, corresponding sides are proportional.	1	0	1	0
(2)	If a straight line is drawn parallel to one side of a triangle, the other two sides are divided proportionally.	1	0	0	0
(3)	If a straight line is drawn parallel to one side of a triangle, the two triangles so formed have their corresponding sides in proportion and their corresponding angles equal.	1	0	0	0
(4)	If a straight line divides two sides of a triangle proportionally, it is parallel to the third side.	1	0	0	0
(5)	If two triangles have corresponding sides proportional they are similar.	1	0	0	0
(6)	If two right triangles have two pairs of corresponding sides proportional, the ratio of the third pair of sides is equal to that of the other pair, and the triangles are similar.	1	0	0	0

		(a)	(b)	(c)	(R)
(7)	If two triangles are similar the triangles are equiangular.	1	0	0	0
(8)	If two triangles are equiangular the triangles are similar.	1	0	0	0
(9)	Two right triangles with one pair pair of corresponding acute angles equal are similar.	1	0	0	0
(10)	If two triangles have an angle of the one equal to an angle of the other and the side about these angles proportional, the triangles are similar.	1	0	0	0
(11)	If two quadrilaterals are similar, corresponding sides are proportional.	1	0	0	0
(12)	If two quadrilaterals are similar corresponding angles are equal.	1	0	0	0
(13)	If two quadrilaterals have corresponding sides and one pair of corresponding angles equal, the quadrilaterals are similar.	1	0	0	0
(14)	If two quadrilaterals have corresponding sides proportional, and have one pair of corresponding angles equal, the quadrilaterals are equal.	1	0	0	0
(15)	The areas of two similar triangles are proportional to the squares on corresponding sides.	0	0	1	2
(16)	The areas of two similar space figures are to each other as the squares on corresponding sides.	1	0	0	2
(17)	The volumes of two similar figures are to each other as the cubes on corresponding sides.	1	0	0	0

Note: With the exception of generalization #1 all other generalizations listed under the heading of Similar Figures appear in only one text, that in the province indicated by the code name F. Generalization #1 is found in two texts, provinces F and A.

XXXIX. Socialized Mathematics.

	(a)	(b)	(c)	(R)
(1) Trade Discount.				
(a) Trade discounts are calculated on the list price of an article.	1	1	0	3
(b) A single rate of discount may be found equal to a discount series.	0	2	0	0
(c) Discounts are often allowed for cash.	0	2	0	1
(d) In calculating successive discounts the first discount is calculated and deducted then the second discount is calculated and deducted etc.	1	0	0	3
(2) Profit and Loss.				
(a) Profit or loss depends upon the relation between cost and selling price.	0	2	0	0
(b) Given the cost and the rate of gain, or loss, reckoned on the cost price required to find the selling price.	0	2	0	0
(c) Given the cost price and the rate of gain based on the selling price, required to find the selling price.	0	2	0	0
(d) Given cost and selling price, to find rate of profit reckoned on cost.	0	2	0	0
(e) Given selling price and rate of gain or loss to find cost.	0	2	0	0
(f) Short methods of determining the selling price of goods bought by the dozen:	0	1	0	0

1. Selling price with a gain of 20% is found by dividing the price per dozen by 10.
2. Selling price with a gain of 80% is found by adding ½ of the selling price for a gain of 20%.
3. For a gain of 60% add 1/3.

	(a)	(b)	(c)	(R)
4. For a gain of 50% add ¼.				
5. For a gain of 40% add 1/6.				
6. For a gain of 33 1/3 % add 1/9.				
7. For a gain of 30% add 1/12.				
8. For a gain of 25% add 1/24.				
9. For a gain of 15% deduct 1/24.				
10. For a gain of 12½% deduct 1/16.				
11. For a gain of 10% deduct 1/12.				
(3) Calculation and preparation of time sheets, pay rolls, pay cheques, etc.	1	0	0	0
(4) Interest.				
(a) The amount of interest earned depends upon three factors; principal, rate and time.	0	2	0	0
(b) Finding the rate of interest when principal, time and interest are given.	0	2	0	0
(c) Finding the time when principal, rate, and interest are given.	0	2	0	0
(d) The use of interest tables to find interest or amount.	0	1	0	0
(e) Finding the principal when rate, time and amount of interest earned is stated.	0	1	0	0
(f) Finding the principal which placed at interest on a given date, at a given rate of interest will produce a given amount at the end of a fixed period of time.	0	1	0	0
(5) Commission.				
(a) To calculate the commission when the rate and gross sales are given.	0	2	0	0
(b) To calculate the commission and net proceeds of sale of goods.	0	2	0	0

	(a)	(b)	(c)	(R)
(6) Insurance.				
(a) Finding the premium when rate and amount of policy is given.	0	2	0	0
(b) To find the amount of premium on various types of life insurance policies by the use of tables.	0	2	0	2
(c) Finding the cash value of lapsed or surrendered life insurance policies.	0	1	0	0
(d) Calculation of the amount of premium to be returned on cancelled policies.	0	1	0	0
(e) A study of the use of co-insurance policies, and calculation of amount to be paid by companies in various types of policies.	0	1	0	0
(f) Problems involving risks shared by several companies.	0	1	0	0
(7) Taxation.				
(a) Required to find the amount of tax, given the rate and assessed value of taxable property.	0	2	0	0
(b) Calculation of income tax, given the income, exemptions, and rate of tax.	0	2	0	0
(8) Banks and Banking.				
(a) To calculate the interest on notes given the rate, time and amount.	0	2	0	0
(b) To calculate the discount on interest bearing notes, given the face of the note, rate of interest, term of discount and rate of discount.	0	2	0	0
(c) Finding date of maturity, term of discount, and discount.	0	1	0	0
(d) Calculating compound interest by calculating yearly interest and adding it on.	0	1	0	0
(e) Calculation of compound interest by use of interest tables.	0	1	0	0

	(a)	(b)	(c)	(R)
(9) Building Construction.				
(a) Finding the number of board feet in a board or plank.	1	0	0	1
(b) Construction of stairs in buildings	1	0	0	0
(c) Construction of Simple framework of buildings.	1	0	0	0
(d) Construction of the roof of a building, cutting of rafters etc.	1	0	0	0
(e) Shingling, involving the method of laying shingles, finding the cost etc.	1	0	0	0
(f) Brickwork	1	0	0	0
(g) Lathing and plastering	2	0	0	0
(h) Carpeting; problems regarding the laying of carpets.	2	0	0	0
(i) Painting, kalsomining, and paving.	2	0	0	0
(j) Papering	2	0	0	0
(k) Stonework, cement work, excavating	2	0	0	0
(10) Agricultural problems. This included miscellaneous questions relating to the operation of a farm such as the cost of feeding cattle, hogs, etc., the cost of fertilizing fields with commercial fertilizers, etc.	1	0	0	0
(11) Problems based on House Economics. This group of problems was intended to acquaint students with comparative food values, family budgets, preserving, sewing and other problems facing the homemaker.	1	0	0	0
(12) Tariffs and Duties.				
Calculation of the duty given the rate and value of the goods.	0	1	0	0

(13) Stocks and Bonds.
A general idea of the relationship of stocks and bonds including such points as:

(a) Differentiation of common vs. preferred stock.

	(a)	(b)	(c)	(R)
(b) Differentiation of Par value vs market value.	0	0	0	1
(c) Types of bonds; Coupon bonds, Registered bonds, etc.	0	0	0	1
(14) Exchange.				
(a) Types of exchange; Foreign, Domestic.	0	0	0	1
(b) Rate of exchange is dependent upon Balance of Trade.	0	0	0	1
(c) The method used to calculate the rate of exchange.	0	0	0	1
XL. Theorem of Pythagoras.				
(1) In a right-angled triangle, the square on the hypotenuse is equal to the sum of the squares on the sides containing the right angle.	1	0	7	8
(2) If a triangle is such that the square on the one side is equal to the sum of the squares on the other two sides, then the angle contained by these two sides is a right angle.	0	0	3	0
(3) In an obtuse triangle the square on the side opposite to the obtuse angle is equal to the sum of the squares on the sides containing the obtuse angle plus twice the rectangle contained by one of these sides and the projection on it of the other.	0	0	1	0
(4) In any triangle, the square on the side opposite to an acute angle is equal to the sum of the squares on the sides containing that acute angle minus twice the rectangle contained by one of these sides and the projection on it of the other.	0	0	1	0
(5) In any triangle, the sum of the squares on any two sides is equal to twice the square on half the third side together with twice the square on the median which bisects the third side.	0	0	1	0

XLI. Triangles.

	(a)	(b)	(c)	(R)
(1) If two triangles have two angles of one respectively equal to two angles of the other and one side of one respectively equal to one side of the other, the triangles are equal.	1	0	8	6
(2) If two angles of a triangle are equal the sides opposite these angles are equal.	1	0	8	5
(3) If two right-angled triangles have their hypotenuses equal, and one side of one equal to one side of the other, the triangles are congruent.	1	0	8	3
(4) If two triangles have two sides of one respectively equal to two sides of the other, and the included angle of each equal, the triangles are congruent.	1	0	7	7
(5) If two triangles have three sides of one equal to three sides of the other, each to each, the triangles are congruent.	1	0	7	6
(6) If two sides of a triangle are equal the angles opposite these sides are equal.	1	0	7	8
(7) An equilateral triangle has all its angles equal.	1	0	4	4
(8) The medians of a triangle trisect each other.	0	0	3	1
(9) The perpendiculars drawn from the vertices of a triangle to the opposite sides are concurrent.	0	0	3	0
(10) If two triangles have two sides of one equal to two sides of the other, each to each, but the angle included by the two sides of one greater than the angle included by the corresponding sides of the other; then the base of that which has the greater angle is greater than the base of the other.	0	0	2	0

Note: This proposition is listed as optional in one of the text books listed above.

	(a)	(b)	(c)	(R)
(11) In an acute-angled triangle the perpendiculars drawn from the vertices to the opposite sides bisect the angles of the pedal triangle through which they pass.	0	0	1	0
(12) The feet of the perpendiculars drawn to the three sides of a triangle from any point on its circum-circle are collinear.	0	0	1	0
(13) To express the relationship between the sides of a triangle and the radii of the inscribed and escribed triangle.	0	0	1	0

a, b, and c denote the sides of the triangle; s the simi-perimeter; r and r_1 the radii of the inscribed and escribed circles. Then the following equalities may be proven:

$AE = AF = s-a$
$BD = BF = s-b$
$CD = CE = s-c$
$AE_1 = AF_1 = s$

$CD_1 = CE_1 = s-b$

$BD_1 = BF_1 = s-c$

$CD = BD_1$ and $BD = CD_1$

$EE_1 = FF_1$ a

The area of the triangle ABC $= rs$
$= r_1(s-a)$

D, E, F are the points of contact of the inscribed circle of the triangle ABC and D_1, E_1, F_1 the points of contact of the escribed circle, which touches BC and the other sides produced.

(14) To express the relationship between the centres of the inscribed circles and the centres of the escribed circles. In the triangle ABC, l is the centre of the inscribed circle, and l_1, l_2, l_3, the centres of the escribed circles touching the sides , BC, CA, AB and the other sides produced.
The following properties may be proven:

The points A, l, l_1 are collinear; so are B, l, l_2; and C, l, l_3.

The points l_2, A, l_3, are collinear; so are l_3, B, l_1. and l_1, C, l_2.

		(a)	(b)	(c)	(R)
	The triangles Bl_1C, Cl_2A, Al_3B are equiangular to one another. The triangle $l_1l_2l_3$ is equiangular to the triangle formed by joining the points of contact of the inscribed circle. Of the four points, l, l_1, l_2, l_3, each is the orthocentre of the triangle whose vertices are the other three. The four circles, each of which passes through three of the points l, l_1, l_2, l_3, are all equal.				
(15)	In any triangle the middle points of the sides, the feet of the perpendiculars from the vertices to the opposite sides, and the middle points of the line joining the orthocentre to the vertices are concyclic. (The nine point circle)	0	0	1	0
(16)	The bisectors of the angles of a triangle are concurrent.	0	0	2	0

XLII. Trigonometric Functions.

		(a)	(b)	(c)	(R)
(1)	The sine of an angle is the ratio of the side opposite to the hypotenuse.	2	0	1	0
(2)	The cosine of an angle is the ratio of the side adjacent to the hypotenuse.	2	0	1	0
(3)	The tangent of an angle is the ratio of the side opposite to the side adjacent.	2	0	1	0
(4)	The sine of any angle is equal to the cosine of its complementary angle.	1	0	0	0
(5)	The cosine of any angle is equal to the sine of its complementary angle.	1	0	0	0
(6)	In a triangle having angles of 45, 45 and 90 degrees the ratio of the sides is $1;1;\sqrt{2}$	2	0	0	1
(7)	In a triangle having angles of 30, 60, and 90 degrees the ratio of the sides is $1;\sqrt{3}:2$	2	0	0	1
(8)	The trigonometric function of an angle which does not appear in the tables may be found by interpolation.	1	1	0	0

XLIII. Verification.

	(a)	(b)	(c)	(R)
(1) Verification of addition by casting out nines.	0	0	1	1
(2) Verification of addition by casting out elevens.	0	0	1	1
(3) Verification of subtraction by the method of adding.	0	0	1	0
(4) Verification of multiplication by casting out nines.	0	0	1	1
(5) Verification of multiplication by the method of casting out elevens.	0	0	1	0
(6) Verification of multiplication by transposing factors and multiplying.	0	0	1	0

Note: The generalizations re verification are presented in only one text book in Arithmetic.

SUMMARY AND CONCLUSIONS.

A total of 478 generalizations under 43 headings have been tabulated as basic to the Grade Ten Mathematics course of the High Schools of Canada. The following conclusions regarding the frequency and occurrence of the generalizations are listed below.

(1) Method of presentation:

Of the total frequencies 17.8% were tabulated as (a), i.e. assumed to be true.

14.8% were tabulated as (b), i.e. assumed to be true, but explained or stated formally.

67.3% were tabulated as (c), i.e. offered with a proof or stated formally.

(2) Table summarizing frequency of generalizations:

No. of generalizations	in	No. of texts.
0		10
8		9
26		8
21		7
24		6
31		5
45		4
28		3
89		2
206		1
478		

The variation in the texts and the programmes of study of the ten provinces is indicated by the fact that no generalization was common to all the texts; only eight of the generalizations were common to nine texts; and 206 generalizations appeared in only one text.

(3) Less commonly presented generalizations:

1. Angles in a Circle.
   2 of the generalizations under this heading were taught in 2 provinces.
   8 of the generalizations in 1 province only.

2. Circles.
   4 generalizations taught in 2 provinces.
   18 generalizations taught in 1 province.

3. Divisibility Test.
   These generalizations appeared in only 1 text.

4. Logarithms.
   These generalizations appeared in only one text and was listed as optional, in the programme of studies.

5. Similar Figures.
   1 generalization appeared in 2 texts.
   16 generalizations appeared in 1 text.

6. Methods of Verification.
   All the generalizations under this heading appeared in only one text.

(4) Number of Grade X generalizations which had appeared in the Grade IX summary.

No. of generalizations	in	No. of Grade IX texts.
5		10
20		9
19		8
12		7
18		6
14		5
14		4
32		3
18		2
37		1
189		

APPENDIX I

THE TEXTS.

The following ten groups of texts were used in making this study. This list was compiled from the 1944-45 Programme of Study for each of the nine provinces. The part of each text to be studied has been indicated and some indication given as to the nature of the text.

<u>British Columbia</u>

A School Algebra (Parts I & II) by H. S. Hall. 1941
MacMillan Co.
Chapters I-XXII to be studied. A detailed presentation of generalizations and vocabulary. Provides many exercises for drill. Formal treatment.

Elementary Geometry - Godfrey & Siddons. 1934
Cambridge Press
Pages 1-126 (Books I & II)
Text divided into experimental and theoretical sections. Formal treatment.

<u>Alberta.</u>

Algebra for Today by Betz, Robinson and Shortliffe.
Ginn & Co.
First five chapters omitting sections 37-38 and 50-51.
A logical treatment.

Geometry for Today - Cook. 1940 MacMillan Co.
First nine chapters. A Socialized treatment.

<u>Saskatchewan.</u>

Ontario High School Algebra - Crawford. 1942
MacMillan Co. of Canada.
Chapters X to XVI: pages 114 - 215 of the prescribed text. A formal treatment.

Plane Geometry - Hall and Stevens. 1935 MacMillan Co.
Pages 43 to 137 omitting the following pages: 75, 76, 77, 85, 91, 92, 104, 105, 107, 109, 116, 133 and 134.
Logical treatment.

Manitoba.

Modern Second Course in Algebra by Wells and Hart. 1931
Copp Clark Co. Ltd.
Chapters I-VI: pages 1-88 omitting pages 57-68 and page 83. Formal treatment.

or

High School Algebra, Crawford. 1942.
MacMillan Co.
Chapters I to XVI: pages 1-215.
Formal treatment.

Geometry for High Schools - Riter and Snyder.
W. J. Gage Co. 1942.
Books I and II, omitting pages 130-142.
Formal treatment.

Canadian Business Arithmetic, Keast.
Pitman and Sons: 1937
The whole text.
Socialized treatment.

Ontario.

General Mathematics, Book Two, Lougheed and Workman.
Macmillan Co. of Canada. 1941.
The whole text.
A semi-formal treatment of an integrated programme dealing with Algebra, Geometry, Trigonometry and Arithmetic.

Protestant Quebec.

Progressive High School Algebra (Revised Canadian Edition.) by Hart. Copp Clark Co. 1940.
Pages 185-193, 264-338, 353-367.
Formal treatment.

Geometry for High Schools.-Lougheed and Workman.
MacMillan Co. 1935.
Pages 92-187 omitting pages 128-131, as well as review of work of previous grades.
Formal treatment.

Catholic Quebec.

High School Algebra, Crawford.
MacMillan Co. 1942.
Pages 115-203.
Formal treatment.

A School Geometry - Parts I - VI, Hall and Stevens.
MacMillan Co. (Great Britian) 1938.
Page 1 - 97. Formal treatment.

New Brunswick.

New Brunswick High School Algebra. Crawford.
MacMillan Co. 1942.
Chapters XIII-XVII inclusive. From chapter XIV omit section number 133 to end of chapter. Particular attention to Chapter XIII.
Formal treatment.

A School Geometry. - Hall and Stevens.
MacMillan Co. 1938.
Parts II and III with exercises. Omit pages 138 and pages 199 to 206 inclusive. From pages 170-171 omit exercises 5,6,7,12,17,18 and from page 181 omit method of limits.
Formal treatment.

Dominion High School Arithmetic.
W. J. Gage & Co. 1941.
Problems on Building Construction, Agriculture, and Home Economics: Practical Problems.
Pages 228 to 266.
Socialized treatment.

Nôva Scotia.

Modern Second Course in Algebra. Wells and Hart.
Copp Clark Co. 1931.
Chapters I-VIII.
Formal treatment.

A School Geometry - Hall and Stevens.
MacMillan Co. 1938.
Pages 1-98 (Part I) omitting pages 66, 68, 76, 84, 85, and all exercises headed (numerical and graphical)
Formal treatment.

Prince Edward Island.

High School Algebra. - Crawford.
MacMillan Co. 1942.
Chapters I-XV, omitting Chapters VII, XII, XIII, XIV.
Formal treatment.

A School Geometry - Hall and Stevens.
MacMillan Co. 1938.
Part I, omitting theorems XIX and XXII with exercises thereon.
Formal treatment.

Dominion High School Arithmetic.
W. J. Gage and Co.
Review of work in Grade IX: Denominate numbers, Fractions, Decimals, Mensuration, and Percentage. Stocks and Bonds: Longi Longitude and time; Exchange: Mensuration, Triangles Parallelogram, circle, Area of circle.
Semi-formal.

APPENDIX II.

PROGRAMMES OF STUDIES.

The following notes were made from the Programmes of Studies for each of the nine provinces.

British Columbia: Lists the seven units to be studied. Gives the objectives, teaching procedures, and vocabulary for each unit in detail.

Alberta: Lists the topics to be studied in Algebra and Geometry. States the objectives and lists some suggestions to teachers. Stress is placed on the use of inventory, diagnostic, and achievement tests. In Algebra emphasis is to be placed on variable and functions.

Saskatchewan: Lists only the parts of texts to be studied.

Manitoba: Lists the texts and parts to be studied. Lists all the propositions to be studied in Geometry.

Ontario: Lists the texts to be studied and gives a detailed statement of topics to be taught. In Geometry stress is to be placed on the analyzing and solving of problems.

Quebec, Protestant: Lists parts of texts to be studied and gives the objectives of the teaching of Algebra and Geometry.

Quebec, Catholic: Lists only texts and parts to be studied.

Nova Scotia: Lists texts with parts to be studied.

New Brunswick: Lists texts and parts to be studied.

Prince Edward Island: Lists the texts and parts to be studied. Gives detailed statement of aims and objectives in the teaching of Arithmetic.

APPENDIX III.

LANGUAGE.

The following terms were selected arbitrarily as language rather than generalizations. The list does not include all the mathematical terms found in the Grade X text books, but includes those terms which it appeared would require to be taught or reviewed at this grade XI. The terms are listed by topics, alphabetically arranged.

Many of the language terms which were listed from the Grade X course had appeared in the Grade IX summary. For that reason the list has been divided into two parts:

(1) The new terms which did not appear in the Grade IX list.
(2) The terms which had already appeared in the Grade IX list.

There was a total of 608 terms tabulated. Of these 198 were listed under the heading of new terms, and 410 were listed as terms which were reviewed.

<u>New List</u>

Abbreviations.

∴	perp.
	sq.
=	rectil.
$\angle$	⊙
	Oce.
$\angle$	opp.
pt.	adj.
st. line.	diag.
rt.$\angle$	m.
	mm.
par^{l}.	cm.
par^{m}.	kg.
	in.
≡	"

Angle, of deviation
    subtended

area, incommensurable

arc, minor
    major

average, cumulative
    moving
    weighted

ambiguous case

bearing, true
    magnetic

checking, methods of

circle, escribed
    circumcircle
    circumradius
    circumcentre

coefficient

collinear

conjugate

constant

construction, hypothetical

co-terminus

curvilinear

curvature, of circles

data

deduction

degree of curve

deviation

diagram

duty, succession
preferential

ellipse

equation, conditional
equivalent
elimination of unknown
of first degree

equidistant

error per cent

exponent, positive
fractional
negative

factoring

figure, space
similar
inscribed
circumscribed

forces, parallel
opposite

function, linear
trigonometric
quadratic

frustrum

generalization

hyperbola

inclination

index, number
notation
weighted

interest, tables

intercepts

logarithms, interpolation
tables
mantissa
characteristic

logarithmation

magnitude

measurement, indirect

measure, linear
square
cubic
board
surveyor's
liquid
dry
paper
weight
time
quantity
money value
weight per bushel
metric, of length
of area
of weight

mean, arithmetic

meridians of longitude

minute

north, magnetic
true

numbers, imaginary
index

operations, direct
inverse
evolution
involution

orthocentre

parallels of latitude

parabola

plotting of points

problem-solving

protractor

polyhedron

powers, ascending
descending

quadrilateral, cyclic
convex
re-entrant

quod erat demonstratum

rhombus

rafters

reducto ad absurdum

representative fraction

roots, real
imaginary
extraneous
rational
irrational

reciprocal

scales, diagonal
sections, cross
longitudinal

slope of a line

surds, quadratic
radical
radicand
radical sign
rationalize

subtraction, subtrahend
difference
minuend

symmetrically opposite

tetrahedron

transposition

time, Atlantic
Eastern
Central
Mountain
Pacific

transit

trigonometric functions
cotangent
cosecant
secant

variation, magnetic
direct
indirect

Socialized Mathematics Terms

banking,
clearing house

building construction,
plank
board
tongued and grooved
"to the weather"
standard brick
lath
roll, of paper
sills

commission, account purchase

discount, invoice price
periods of
proceeds
net price

depreciation

duties, most favored nation
general rate

succession duties

duties, sales tax
stamp tax
special manufacture and import tax.

exchange, bill of
foreign
domestic
balance of trade
course of exchange
arbitration of exchange

insurance, limited pay life
mortality tables
group insurance

inventory

index numbers, weighted index

ledger

pay roll and wages, overtime
time sheet
pay roll
pay roll cheque
time card
piecework

Review List

absolute value

addition - addend
sum
indicated

algebra - algebraic
altitude
approximation
area
axiom
angle - vertex
arm
alternate
degree
minute
second
included
supplementary
supplement
complementary
complement
elevation
depression
straight
right
acute
obtuse
reflex
exterior
interior
adjacent
vertically opposite
corresponding

base, of figure
exponent

bisector - right
internal
external

brickwork - superficial feet

circle - semicircle
circumference
arc
chord
sector
diameter
radius
tangent
point of contact
concentric
centre
inscribe
circumscribe
segment
quadrant

coefficient, numerical
literal

collect (terms)

combine (terms)

corollary

cube root

cyclic order (of denominators)

decimal - decimal point
recurring

density

division - divisor
dividend
quotient
remainder

discount

digit

due

definition

diagonal

equation - unknown
root
linear
simultaneous
solution
solve
satisfy
verification
left side
right side
identity
quadratic
consistent
inconsistent
dependent
independent
determinate
indeterminate

error, possible
probable

evaluation

expression - terms
- simple
- compound
- monomial
- binomial
- trinomial
- polynomial
- multinomial

factor - literal
- numerical
- prime
- highest common

figure - plane

formula - subject of,

function

fraction - common
- vulgar
- numerator
- denominator
  - common
  - lowest common,
- proper
- improper
- compound
- complex
- lowest terms
- equivalent
- aliquot parts
- cancellation

geometry - geometric

gravity, specific

graph - bar
- circle
- broken line
- curved line
- coordinate
- axis
- ordinate
- abscissa
- origin

index
length

line, horizontal
- vertical
- oblique
- straight
- broken
- curved
- concurrent
- segment

locus

longitude
measurement, units of
- link
- fathom
- chain
- acre

metric system - millimetre
- centimetre
- decimetre
- metre
- dekametre
- hectometre
- kilometre
- gram
- kilogram

multiplication - multiplier
- multiplicand
- product

multiple - least common
- lowest common

notation

number, signed
- directed
- negative
- positive
- mixed
- whole
- prime
- round

order, ascending
- descending

parallels
parenthesis
perpendicular

percent

perimeter

plane

point

postulate

projection, orthogonal

proportion, proportional
simple
extremes
means

power,

proposition, theorem
problem
enunciation
general
particular
hypothesis
conclusion
construction
proof
indirect method
converse

quantity - known
unknown

ratio

reciprocal

rectilineal figures -
triangle
quadrilateral
trapezium
trapezoid
parallelogram
rectangle
square
rhombus
polygon
penta
hexa
octa
deca
equilateral
equiangular
regular

roof, rise
run
pitch

scale

scale drawing

signs, of operation
of quality

significant figures

simplify

surface, plane
curved

solid - cube
rectangular
rectangular parallelepiped
cuboid
cylinder, right circular
lateral area
cone, right circular
prism
sphere
pyramid, regular
triangular
square
pentagonal
hexagonal

symbol

symmetry, axis of
centre of

square

superposition

stairs, rise
riser
nosing
run

stone work

square root, root
root sign
principal
radical sign

terms, like
unlike

temperature, Fahrenheit
Centigrade
degree

time, standard

table of values

trigonometric ratios,
sine
cosine
tangent

triangle, sides
base
vertex
congruent
equilateral
equiangular
isosceles

triangle,
- scalene
- right-angled
- obtuse-angled
- acute-angled
- similar
- hypotenuse
- median
- corresponding angles

verify

variable

value, absolute

vinculum

Socialized Mathematics Terms

banking, deposit
- deposit slip
- bank book
- current account
- savings account
- cheque
- cheque book
- endorse
- exchange
- credit
- promissory note
- bank discount

bond, par value
- coupon
- rate
- register
- mature
- mortgage bond
- market price
- quotation
- accrued interest

customs, duties
- excise
- tariffs
- ad valorem
- specific

commission, principal
- consignor
- consignee
- shipment
- proceeds, net
  - gross

insurance, property
- personal
- premium
- policy
- face value
- face of policy
- loan value
- cash surrender value
- ordinary life
- limited pay life
- endowment
- term

interest, rate
- simple
- compound
- principal
- amount
- annual
- semi-annual
- quarterly

investment

discount, commercial
- trade
- successive

draft, drawer
- drawee
- payee
- debtor
- creditor

notes, promissory
- face
- time
- date of maturity
- discount, terms of
- proceeds
- days of grace
- maker
- payee
- negotiable
- non-negotiable
- endorsement

mortgage,

price, list
- catalogue
- invoice

profit and loss, net cost
overhead
marked price
selling price
gain

taxation, direct
indirect
budget
income tax
normal
exemptions
additional tax
dependents
appraise
mill rate
assessor
assessment
valuation
real estate tax
personal property tax
poll tax

stocks, capital
share
shareholder
stock certificate
par value
nominal value
market value
capitalized
dividends
preferred
common
stock exchange
quotations
brokerage
broker
corporation
joint stock company
stockholder
discount
premium